# PRELIMINARY DESIGN OF METHANOL PLANT FROM COAL WITH GASIFICATION PROCESS CAPACITY OF 150,000 TONS/ YEAR

**FINAL PROCET**

Asked to Meet Requirements Achieved Bachelor Degree in Strata 1 Engineering at Chemical Engineering Department Faculty of Engineering Universitas Muhammadiyah Surakarta


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**UNIVERSITAS MUHAMMADIYAH SURAKARTA**


**2017**

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## FACULTY OF ENGINEERING

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Surakarta, Februari 2018

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**STATEMENT OF AUTHENTICITY OF THE FINAL PROJECT**

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States that the results of the final project I make and submit are the work of my own, excepts from summaries I have all explained from the source. If in the future it can be proved that this final project, then I will be willing to accept sanction in accordance with the applicable regulations.

Surakarta, Februari 2018

The state,

College Student

**Aisyah Itsnaini S.**

D 500 122 001

DEDICATION

Bismillahirahmanirrahim

*I dedicate this work to:*

*My parents, Siswanto and Sri Yuniati. Thank you for your endless love and support me.*

*Many thanks for :*

*My sister, Istiqomah for believe, and support me. You're my vitamin.*

*My cute, best friends, and vitamines classmate Anggie F. Asokawati, Aisyah Hanifah, Delta Mutiara, Diah Ayu Anggraeni, Imala Septi Cahyani, Salam Nurdin Aridin, Yulira Kus Rendra. We through all things together. You're best gift in my college life. I hope we still keep contact each others. Please be happy and wish you all the best.*

*My partnert Anggie F. Asokawati who always believe, and support. Sorry for these years. I make so much mistakes, but thank you for always stay in my side, listen to me, and believe me. Wish you all the best.*

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*My chat buddies Sofia Rahmawati and Shinta Wulandari who always help and support me. Thank you for accommodating me. Wish you all the best.*

*My friends in chemical engineering UMS 2012, senior and junior, and friends in K.H. Mas Mansyur. Thank you for makes so much memorries with me and thanks for you're help and support me. I wish you all the best, and see you next time.*

*Lecturers and staffs in department chemical Engneering UMS 2012. Thank you so much for support, guidance and encouragment.*

*May Allah S.W.T bless us all.*

*Thank you so much and wish you all the best.*

# PREFACE

Alhamdulillahirobbil ‘alamin, praise is merely to Almighty Allah SWT for gracious mercy and blessing, so this final project has been completed.

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2. Kusmiyati, S.T., M.T., Ph.D as Supervisor I
3. M. Mujiburohman, S.T., M.T., Ph.D as Supervisor II
4. Lecturers in Chemical Engineering Department, Universitas Muhammadiyah Surakarta
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6. Family and friends who have given endorsement and prayer
7. Everyone who has supported

Due to limitations in preparation of this report, author aware that this report might have some shortcomings.Therefore suggestion and constructive criticism to improve this report are welcome. Author wish this report will be useful for all those who concern.

Surakarta, 30 Januari 2018

Aisyah Itsnaini S.

## LIST OF CONTENTS

## LIST OF TABLE

## LIST OF FIGURE

## ABSTRACT

Methanol ($CH_3$) is one of the hydrocarbon compounds of the alcohol group ($CnH_2n+2O$) with an alkyl hydroxyl group (-OH). Dervative products of Methanol is acetic acid, MTBE, rubber, formaldehyde, etc. In Indonesia alone consumption of Methanol needs quite a lot, and raw material is very much. The raw material can take from Sumatera or Kalimantan. The plant is planned to establish in Sangatta area, East Kalimanatan in 2025, because near with raw material, utility, transportation. The land area is 3,800$m^2$ and hire 159 employees.

The process of Methanol is in raw materials preparation stage, coal needed is 18,939.394 kg/hour, water 8,234.519 kg/hour, and oxygen 49,242.424 kg/hour. That will be heated in Gasifier Reactor with pressure 50 atm and temperature 600°C. Then input to Water Gas Shift Reactor (WGSR), at process stage will be react with water so $CO_2$ content will increase using catalyst CuO-ZnO-$Al_2O_3$ with pressure 49 atm and temperature 409°C. Then input to Fix Bed Reactor (FBR), CO and $CO_2$ will be react with hydrogen to produce methanol and water content using catalyst CuO-ZnO-$Al_2O_3$ at pressure 48 atm and temperature 200°C. At purification product stage, methanol and water are separated by distillation process. Methanol purification by distillation process to obtain methanol content is 99%. Supporting unit of the plant consist of water supply as much as 968,907 kg/hour which are processed from Mataram River, provision 21,038.298 kJ/hour of saturated steam, 34,970.805 kJ/hour of superheated steam, provision 998 kW of electricity, provision 236 liters/hour of diesel fuel, and provision 3,252 kg/hour of ammonia.

Amount of working capital is USD $105,381,928 and Fix Capital Investment (FCI) is $12,184,852.33. The economic analysis shows that Return On Investment (ROI) before tax is 59.93% and after tax is 45.24%. Pay Out Time (POT) before tax is 1.43 years and after tax is 1.9 years. Break event-point (BEP) is 47.74% capacity, Shut down point (SDP) is amounted at 39.57% capacity, and Discounted cash flow (DCF) is 30.28%. From data results of feasibility analysis can be concluded that the plant is profitable and feasible to be established.